UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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First Named Inventor or Application Identifier	
NOBUYUKI NAKAJIMA	
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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [ ] Fee Transmittal Form *(Submit an original, and a duplicate for fee processing)*
2. [X] Specification — *Total Pages* 45
3. [X] Drawing(s) *(35 USC 113)* — *Total Sheets* 22
4. [X] Patent Application Bibliographic Data Sheet — *Total Sheets* 1
5. [ ] Oath or Declaration — *Total Pages*
   - a. [ ] Newly executed (original or copy)
   - b. [ ] Unexecuted for information purposes
   - c. [ ] Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 18 completed)* ***[Note Box 6 below]***
     - i. [ ] DELETION OF INVENTOR(S) Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Incorporation By Reference *(useable if Box 5c is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 5c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

ADDRESS TO:

Commissioner for Patents
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Washington, DC 20231

7. [ ] Microfiche Computer Program *(Appendix)*
8. [ ] Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   - a. [ ] Computer Readable Copy
   - b. [ ] Paper Copy (identical to computer copy)
   - c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [ ] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
11. [ ] English Translation Document *(if applicable)*
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. [ ] Small Entity [ ] Statement filed in prior application Statement(s) Status still proper and desired
16. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
17. [ ] Other: _____

18. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. __/_____

Prior application information: *Examiner* _____ *Group/Art Unit:* _____

19. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label — 05514 (Insert Customer No. or Attach bar code label here) — or [ ] Correspondence address below

NAME					
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City		State		Zip Code	
Country		Telephone		Fax	

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	18-20 =	0	X $ 18.00 =	$0
	INDEPENDENT CLAIMS (37 CFR 1.16(b))	6-3 =	3	X $ 78.00 =	$234.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			$260.00 =	$0
				BASIC FEE (37 CFR 1.16(a))	$690.00
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				TOTAL =	$924.00

20. Small entity status
    - a. ☐ A small entity statement is enclosed
    - b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
    - c. ☐ Is no longer claimed.

21. ☒ A check in the amount of $ 924.00 to cover the filing fee is enclosed.

22. ☐ A check in the amount of $ _____ to cover the recordal fee is enclosed.

23. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:
    - a. ☒ Fees required under 37 CFR 1.16.
    - b. ☒ Fees required under 37 CFR 1.17.
    - c. ☐ Fees required under 37 CFR 1.18.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED		
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Title Line Two:: MEDIUM AND CHART THEREFOR

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PRIOR FOREIGN APPLICATIONS

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Foreign Application Two:: 11-263919
Filing Date:: 09-17-99
Country:: JAPAN
Priority Claimed:: Yes

IMAGE PROCESSING METHOD, APPARATUS, RECORDING MEDIUM AND CHART THEREFOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image processing method for reading a chart and generating correcting conditions based on the obtained data, and an apparatus and a recording medium therefor.

Related Background Art

In the printing apparatus, it is already known that the printing characteristics may fluctuate depending on the environmental conditions such as the temperature and humidity of the environment in which the apparatus is used. In addition to such environmental conditions, the printing characteristics may be varied after the use of a certain period. For example in the printing apparatus based on the electrophotographic process, the photosensitive characteristics of the photosensitive drum vary according to the environmental conditions as mentioned above or by the prolonged use, whereby the printing characteristics such as gradation observed on the printed image shifts from the desired value. Also the printing apparatus based on the ink jet system is known to show such change in the printing characteristics because of a change in the discharge

characteristics of the printing head.

Calibration is executed for such change in the printing characteristics, but it is not limited to the change in the printing characteristics of the individual printing apparatus. In an information processing system in which plural printing apparatus are connected through a network, the difference in the above-mentioned printing characteristics between such printing apparatus may become an issue, and the calibration becomes necessary in order to reduce the difference in the printing characteristics among the printing apparatus. Conventionally, such calibration is basically executed according to an instruction entered by the user. For example, in case the user observes that the gradation of the printed image is different from the desired one, the user instructs the execution of calibration on an operation image displayed on the printing apparatus or on a personal computer (PC).

For a highly precise calibration, it is necessary to measure, with a high precision, a calibration chart outputted by the printing apparatus.

It is therefore necessary to stabilize and optimize the characteristics of the scanner apparatus used for reading the chart.

However, the calibration for the scanning apparatus for stabilizing and optimizing the

characteristics thereof has not conventionally executed.

Consequently, a highly precise calibration for the printer apparatus cannot be achieved if the characteristics of the scanner apparatus are deviated.

SUMMARY OF THE INVENTION

An object of the present invention is to enable calibration of the reading unit, thereby enabling constantly precise calibration of the image forming unit.

Another object of the present invention is to improve convenience of use of the calibration process for the reading unit and that for the image forming unit.

Still another object of the present invention is to prevent misuse of the chart to be used in the calibration process for the reading unit and that for the image forming unit.

The foregoing objects can be attained, according to the present invention, by an image processing method comprising:

a step of generating a calibration condition for image forming unit, by reading a first chart formed by the image forming unit with reading unit and generating a calibration condition for the image forming unit, based on the data obtained by the

reading:

a step of generating a calibration condition for the reading unit, using a second chart printed in advance; and

a discrimination step of discriminating the first and second charts;

wherein the discrimination step discriminates whether a chart read in each of the step of generating calibration condition for image forming unit and the step of generating calibration condition for image reading unit is an appropriate chart.

Still another object of the present invention is to improve the storability of a chart to be used for calibrating the reading unit thereby maintaining the accuracy of the calibration process.

The foregoing object can be attained, according to the present invention, by an image processing method for entering read data obtained by reading a chart printed in advance with reading unit and generating calibration data for calibrating the reading unit based on the read data:

wherein the chart is rendered foldable with the printed surface thereof inward and is not printed with a data patch in the vicinity of the folding portion, and the chart is stored in an operation manual of the image processing method in a state folded in the folding portion with the printed surface thereof

inward.

Still other objects of the present invention, and the features thereof, will become fully apparent from the following detailed description, which is to be taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an example of configuration of a printer calibration system;

Figs. 2A and 2B are views showing an example of inverted placement of a printer calibration system of a second embodiment;

Fig. 3 is a view showing an example of skew of a printer calibration system of a third embodiment;

Fig. 4 is a flow chart showing the process flow of printer calibration;

Figs. 5A, 5B and 5C are charts showing the concept of calibration data preparation;

Fig. 6 is a view showing an example of the printer chart to be used in the printer calibration system;

Fig. 7 is a flow chart showing the process flow in receiving a calibration data download command in the printer apparatus;

Fig. 8 is a flow chart showing the flow of U1 in an application;

Fig. 9 is a view showing an example of U1 in an

application;

Fig. 10 is a table showing the correspondence between output signals of patch data and arrangement numbers;

Fig. 11 is a flow chart showing the flow of image processing in a printer;

Fig. 12 is a flow chart showing the flow of scanner calibration in a first embodiment;

Fig. 13 is a flow chart showing the process flow in a second embodiment;

Fig. 14 is a flow chart showing the process flow for detecting inverse placement in the second embodiment;

Fig. 15 is a view showing an example of the scanner chart to be used in the printer calibration system;

Fig. 16 is a view showing an example of error display in a third embodiment;

Fig. 17 is a view showing an example of error display in a second embodiment:

Fig. 18 is a flow chart showing the process flow of chart detection in the first embodiment;

Fig. 19 is a flow chart showing the process flow in the third embodiment;

Fig. 20 is a flow chart showing the flow of a screw detection process in the third embodiment;

Fig. 21 is a view showing an example of the

scanner chart in a fourth embodiment; and

Figs. 22A and 22B are views showing an example of method for storing the scanner chart.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now the present invention will be clarified in detail by embodiments thereof with reference to the accompanying drawings.

The following embodiments employ a color laser beam printer as an example of the printer constituting the system, but the present invention is naturally applicable likewise to other printers such as a color ink jet printer.

[First Embodiment]

Fig. 1 is a block diagram showing the configuration of a printer calibration system constituting the present embodiment.

In the present embodiment, the form of connection in the network and the protocol therein are not particularly referred to, but there may be adopted any connection form and protocol in a similar manner.

Referring to Fig. 1, a software realizing the present system is installed in a server PC 1, which is connected to a network 5.

A scanner calibration data storage unit 11 stores scanner calibration data explained in later and stored in the server PC 1.

A printer 2 connected to the network 5 is subjected to the calibration in the present system, and is rendered capable of printing operation from instructions from plural PC's connected on the network. A calibration data storage unit 21 provided in the printer 2 is used for storing calibration data to be explained later, when such data are downloaded from the PC 1.

A scanner 3 connected to the server PC 1 is used as a densitometer for measuring the density of patch data outputted by the printer 2, but it is also usable for its original purpose of entering an original. In measuring the patch data outputted by the printer, the scanner 3 is calibrated by a scanner chart prepared in advance for enabling stable density measurement by the server PC 1, and the scanner calibration data thus prepared are stored in the scanner calibration data storage unit 11 mentioned above. A client PC 4 connected to the network is used for preparation and editing of desired print data and for instructing a printing operation. In general, the printer calibration is executed by a system manager on the server PC 1, while the ordinary printing of the print data is executed in the client PC 4.

In the following there will be explained, with reference to Fig. 4, the process flow of printer calibration in the above-described configuration.

A step S41 outputs patch data from the server PC 1 to the printer 2, thereby causing the printer 2 to output a printer chart. In this operation, an object printer is specified, assuming a situation where plural printers are connected on the network. This is achieved according to the rule of network management which is not explained herein.

Fig. 6 shows an example of the printer chart. In Fig. 6, a printer chart is shown in a frame 61 of A4 size in this case. A data portion 62 for knowing the density characteristics of the printer consists, in the example shown in Fig. 6, of 1024 blocks in total, composed of 32 divisions in the vertical and lateral directions. In the lateral direction, the blocks are arranged respectively for cyan, magenta, yellow and black which are basic colors of the toner. The number in each block is an arrangement suffix or number, which is correlated with the actual value as shown in Fig. 10. More specifically, the arrangement number 0 corresponds to an actual output data 0, the number 32 corresponds to an actual output data 128, and the number 63 corresponds to an actual output data 255. In a system of 8 bits for each of CMYK, there are employed values from 0 to 255, but the values in Fig. 10 may be modified for another number of bits.

More specifically in Fig. 6, in the highlight side with the arrangement numbers from 0 to 31, there

are provided 4 blocks of 32 gradation levels, and, in the shadow side with the arrangement numbers from 33 to 63, there are provided 8 blocks of 16 gradation levels. The difference in the number of gradation levels between the highlight and shadow sides is based on a fact that the present system required more detailed gradation information in the highlight side than in the shadow side. Also the difference in the number of arranged blocks between the highlight and shadow sides is based on a fact that the fluctuation in the input value of the scanner tends to be larger in the highlight side than in the shadow side.

In Fig. 6, discrimination information 63 is provided for the discrimination to be explained in the following. The discrimination information is shaped as an arrow for indicating the direction of the chart when it is placed on the original supporting table of the scanner apparatus, and contains therein a letter "B" for causing the user to identify this chart as a printer chart.

In Fig. 6, registration marks 64, 65, 66 are provided for detecting whether the chart is properly placed on the original supporting table of the scanner.

The above-described printer chart is outputted from the printer 2 in response to an instruction given from the server PC 1 through the network. The chart

may be generated by storing information for constituting the patch data of the above-described format in the printer 2 and generating the patch data from such information in response to the instruction from the PC 1, or by generating the patch data by transmitting the information for constituting the patch data from the PC 1 to the printer 2. The information for constituting the patch data is dependent on the command system belonging to the printer 2, but will not be explained further.

Referring to Fig. 4, a step S42 discriminates whether the scanner apparatus 3 of the present system is already calibrated. This discrimination can be achieved by judging whether a luminance-density conversion table to be explained later, namely scanner calibration data, is stored in the scanner calibration data storage unit 11 in the server PC 1. If the scanner calibration is already executed, the sequence proceeds to a step S44, but, if not yet executed, the sequence proceeds to a step S43 for executing the scanner calibration.

The flow of scanner calibration will be explained with reference to Fig. 12. In Fig. 12, a step S120 at first executes reading of a scanner chart, which is similar to the aforementioned printer chart showing in Fig. 6 but is different in the purpose.

Fig. 15 shows an example of the scanner chart.

In Fig. 15, an entire scanner chart is shown by a frame 151 of A4 size. A data portion 152 consists, as in the example shown in Fig. 6, of 1024 blocks in total, composed of 32 divisions in the vertical and lateral directions.

Discrimination information 153 is provided for the discrimination to be explained in the following. The discrimination information is shaped as an arrow for indicating the direction of the chart when it is placed on the original supporting table of the scanner apparatus as in the case of Fig. 6, but contains therein a letter "A" for causing the user to identify this chart as a scanner chart. The arrow constituting the discrimination information in the printer chart shown in Fig. 6 is colored with a certain solid color (for example cyan color), while the arrow constituting the discrimination information in the scanner chart shown in Fig. 15 is colored with another solid color (for example magenta color) and is used for the discrimination to be explained later. Registration marks 154, 155 shown in Fig. 15 will also be explained later.

The above-described scanner sheet is a reference sheet, printed in advance for example by offset printing, and is therefore different from the printer chart outputted from the printer in the aforementioned step S41.

Consequently the scanner chart need not to assume the format shown in Fig. 6, but such format will be taken as an example in the present embodiment. In such case, the printer chart shown in Fig. 5 and the scanner chart shown in Fig. 15 look similar, and may cause misuse by the user.

A step S121 discriminates whether a proper chart is used. As the scanner calibration is intended in this case, there is discriminated whether the chart is the scanner chart A.

The flow of such discrimination will be explained with reference to Fig. 18. A step S181 executes detection of the lower left registration mark 155. Since the size of the chart is determined in advance, the number of pixels between the data constituting the chart can be uniquely determined by fixing the scanning resolution of the scanner apparatus. The discrimination process shown in Fig. 18 is executed after the step S120 in Fig. 12 stores the data of the chart of A4 size in a memory.

The detection of the lower left registration mark 155 is executed by searching a black (non-white) area of a pixel number corresponding to such registration mark, within an area predetermined from the lower left corner of the A4 sized-area. If a step S182 identifies a failure in detection the lower left registration mark, a step S183 returns an error

signal. If a registration mark detection error signal is returned in this discrimination step, a step S122 in Fig. 12 executes an error display. An example of such error display is shown by 173 in Fig. 17. An error window 173 is displayed on the personal computer. The displayed error message transmits the user to repeat the reading operation after confirmation of the position of the chart to be measured and the reading resolution, and the chart reading is executed again in the step S120.

If step S181 succeeds in detecting the lower left registration mark, a step S184 executes detection of the upper left registration mark. The detection of the upper left registration mark 154 is executed by searching, within the memory, a black (non-white) area of a pixel number corresponding to such upper left registration mark, within a predetermined area separated upwards by a predetermined pixel number from the lower left registration mark. If a step S185 identifies a failure in detecting the upper left registration mark, a step S183 returns an error signal whereby the error display 173 shown in Fig. 17 is executed as in the aforementioned flow.

If a step S184 succeeds in detecting the upper left registration mark, a step S186 discriminates the color of the arrow constituting the discrimination information 153 in Fig. 15. The arrow 153 is provided

in a position in the memory separated by a predetermined pixel number to the right from the aforementioned upper left registration mark. The color is discriminated by referring to the RGB signal of the pixels in such position. More specifically, the cyan color can be identified by discriminating whether the RGB signals respectively assume values 0, 255, 255. In practice, in consideration of the fluctuation of characteristics of the scanner and of eventual smear of the chart, several pixels within the arrow mark are sampled and averaged, and there is discriminated whether the RGB values are respectively within a range around 0, 255, 255. If the step S186 identifies the cyan color, a step S187 identifies the printer chart, whereupon the discrimination step is terminated.

If the step S186 does not identify the cyan color, a step S188 identifies a scanner chart, whereupon the discrimination step is terminated.

If the aforementioned discrimination identifies the printer chart, a step S121 discriminates that the chart is not correct, and a step S122 executes an error display. Fig. 17 shows an example 171 of such error display, which is an error window display on a personal computer. After such error message requests that the user is to replace the scanner chart on the original supporting table of the scanner, the reading

of the chart is executed again in the step S120. The chart discrimination explained above avoids the misuse of the scanner chart and the printer chart by the user.

A step S123 loads density data, obtained by measuring in advance the above-mentioned scanner chart with a densitometer or the like. Such density data are stored in advance in the server PC 1. Thus the scanner chart and the density data are correlated comprehensively and the scanner calibration to be explained in the following is executed, based on such correlation. A step S124 prepares a luminance-density conversion table, based on the relationship between the RGB scanner signals read in the step S120 and the CMYK density information loaded in the step S123. Such step constitutes the scanner calibration.

The above-mentioned table is prepared for each of CMYK colors. The table is so constructed, for a scanner input value x for a block within the aforementioned scanner patch data, as to output an output y indicating the actual density of such block and obtained from the above-mentioned density data. It is thus rendered possible to obtain a comprehensive luminance-density converting relationship by repeating the scanner calibration in case the input characteristics of the scanner vary or for a different kind of scanner.

In the present embodiment, for measuring the patch density, the R data generated in the scanner are used for measuring the C patch density, while the G data are used for measuring the M patch density, the B data are used for measuring the Y patch density, and the G data are used for measuring the K patch density. Thus, the luminance-density conversion table is prepared for each of CMYK colors, based on the RGB luminance data corresponding to the CMYK patches and the density information loaded in the step S123.

The scanning operation is executed by a scanner driver constituted usually on the PC 1. Such scanner driver executes setting of the scanning resolution and designation of the input area.

Then a step S44 in Fig.4 executes measurement of the aforementioned printer chart by the scanner 3.

The scanner 3 receives the RGB values of the blocks of the aforementioned patch data and sends such values to the PC 1. Based on such input signals and the block arrangement of the aforementioned patch data, the PC 1 calculates the averages of four positions at the highlight side and those of eight positions at the shadow side, thereby obtaining RGB signals of 48 gradation levels for each of CMYK colors. Then, based on the aforementioned luminance-density conversion tables prepared in advance by the aforementioned scanner calibration and

showing the correspondence between the RGB luminance signals of the scanner 3 and the CMYK density signals of the printer 2, the density characteristic values of 48 gradation levels are obtained from the luminance signals of 48 gradation levels.

Then, as in the aforementioned scanner calibration, a step S45 discriminates whether the chart used is a proper chart. As the scanner calibration is intended in this case, there is discriminated whether the chart is the printer chart B. The flow of such discrimination is as explained in the foregoing with reference to Fig. 18, and is executed after a step S44 stores the data of the chart of A4 size in the memory. More specifically, a step S181 in Fig. 18 detects the lower left registration mark, and a step S184 detects the lower left registration mark. In case of failure in detecting these registration marks, a step S46 executes an error display 173. The displayed error message transmits the user to repeat the reading operation after confirmation of the position of the chart to be measured and the reading resolution, and the chart reading is executed again in the step S44.

A step S186 discriminates the color of the arrow constituting the discrimination information 63 in Fig. 6. If the step S186 identifies the cyan color, a step S187 identifies the printer chart, whereupon the

discrimination step is terminated. If the step S186 does not identify the cyan color, a step S188 identifies a scanner chart, whereupon the discrimination step is terminated.

If the aforementioned discrimination of the step S45 identifies the scanner chart, there is discrimination that the chart is not correct, and a step S46 executes an error display. Fig. 17 shows an example 172 of such error display, which is an error window display on a personal computer. After such error message requests that the user is to replace the printer chart on the original supporting table of the scanner, the reading of the chart is executed again in the step S44. The chart discrimination explained above avoids the misuse of the scanner chart and the printer chart by the user.

Then a step S47 executes preparation of a calibration table in the server PC 1. The mode of preparation will be explained with reference to Figs. 5A to 5C. Fig. 5A shows the density characteristic values of 48 gradation levels of each color. Though only one color is shown for the purpose of simplicity, similar processes are executed in practice for the CMYK colors. Figs. 5A to 5C show curves indicating the relationships between input and output, to be determined by interpolating calculation from the aforementioned 48 gradation levels. The ideal density

characteristics are defined as a linear curve as shown in Fig. 5C. Therefore, for bringing the current density characteristics shown in Fig. 5A to the ideal density shown in Fig. 5C, a calibration table shown in Fig. 5B is determined by an inverse function. Thus, the characteristics in Fig. 5C are obtained by applying the characteristics in Fig. 5B to the characteristics shown in Fig. 5A.

Then a step S44 causes the server PC 1 to execute the downloading of the calibration table data to the printer 2 through the network.

In this operation, as in the aforementioned case of chart output, the object printer is specified, assuming that plural printers are connected on the network. The downloaded calibration data are stored in the calibration data storage unit 21. The download command in this operation depends on the command system of the printer 2 but will not be explained further herein.

Now there will be explained, with reference to Fig. 7, the process flow in receiving the downloaded data by the printer 2. A step S70 in Fig. 7 discriminates whether data have been received. If not received, the step S70 is repeated. If received, a step S71 executes data analysis. A step S72 discriminates the result of such analysis, and if it is a calibration data download command, a step S73

stores the calibration data in the calibration data storage unit 21. If the step S72 identifies that the result is not the calibration data download command, a step S74 executes a process matching the data.

The ordinary print data are transferred from an application on the PC 1 through a printer driver thereon to the printer 2. In the step S74 etc. in Fig. 7, the printer 2 executes analysis of print data, page layout constitution, image processing, printing etc. In the following there will be explained, with reference to Fig. 11, the process flow of image processing with the calibration data in the printer 2. At first a step S110 executes fine color adjustment on the RGB input signals, consisting of luminance correction and contrast correction. Then a step S111 executes color matching, for matching the hue of the monitor with that of the print. Then a step S112 executes luminance-density conversion, for converting the input RGB luminance signals into the CMYK density signals which are print signals for the printer. Then a step S113 executes a calibration process for obtaining linear output characteristics for the CMYK signals of 8 bits each, utilizing the aforementioned calibration data. Then a step S114 converts the CMYK signals of 8 bits each, into signals matching the output system. In general there is executed binarization input YMCK signals of one bit each.

In the following there will be explained, with reference to Figs. 8 and 9, the flow of a user interface (U1) of a printer constituting system in the PC 1. This printer constituting system is constituted as an application on the server PC 1.

At first a step S81 displays a main image, of which an example is shown in Fig. 9. The image shown in Fig. 9 and other images are basically so constructed that the display shifts to other related images by depressing buttons "next", "return", "cancel" and "help". In the main image shown in Fig. 9, there are provided three menu selections "new", "open existing measurement data" and "delete download data". If "new" is selected and "next" is depressed, the sequence proceeds to a step S82 for outputting the chart data to the printer 2. Then a step S85 executes calibration of the scanner 3 by the PC 1 as explained in the foregoing, and prepares the luminance-density conversion table specific to the scanner 3. Then a step S87 executes measurement of the chart in the scanner 3 utilizing the aforementioned luminance-density conversion table, as explained in the foregoing. A next step S88 applies calibration. This step executes the step S43, S44 in Fig. 4, namely preparation of the calibration data and downloading of the data to the printer 2. In a next step S88, there is provided a button for shifting to a step S89, and a

shift thereto is realized by the depression of such button by the user. A step S89 enables storage of the measurement data, and is used for storing the scan data measured in the step S87. Thus stored file can be used in a process flow utilizing the existing measurement data as will be explained later. After the step S89, the sequence returns to the step S88. Then a step S810 displays a processing ending image, and the process is terminated if the end of application is designated on such image, but the sequence returns to the step S81 if returning to the main image is designated.

If "open measurement data" is selected and "next"is depressed in the main image of the step S81, there is displayed an image of the step S83 for designating the measurement data. By depressing a "reference" button, the display shifts to an image of the step S86 for reading the measurement data, thereby enabling detailed search of the measurement data. The measurement data are the data file stored in the foregoing step S89. Then the photoelectric conversion 88 applies the calibration. The flow thereafter is same as that explained in the foregoing.

If "delete download data" is selected and "next" is depressed in the main image of the step S81, a step S84 deletes the calibration data stored in the calibration data storage unit 21. This operation is

executed by a command from the PC 1 to the printer 2, but the command is not explained further.

Then the sequence proceeds to the ending image of the step S810, and the subsequent flow is same as explained in the foregoing.

In the present embodiment, as explained in the foregoing, it is necessary to specify the object printer, assuming that plural printers are connected on the network, and such operation is executed on the U1 at the printing of the printer chart in the step S82 in Fig. 8. The application executes instruction for chart output and downloading of the calibration data to the designated printer.

In the foregoing there has been explained, with reference to Figs. 8 and 9, the flow of the user interface (U1) of the printer calibration system functioning as an application on the PC 1.

As explained in the foregoing, the present embodiment allows to constantly execute color printing in stable manner.

It is also possible to improve the convenience of use of the calibration process for the scanner and for the printer. In particular, it is possible to prevent erroneous use of the charts.

The characters provided for identifying the charts in the arrow-shaped mark thereof may naturally be replaced by other characters or words.

[Second Embodiment]

In the following there will be given a detailed explanation on a second embodiment of the present invention.

In contrast to the first embodiment designed to execute automatic discrimination and to provide error display in case the scanner chart and the printer chart to be used in the calibration are erroneously used by an operation error of the user, the second embodiment is so designed as to detect an inverse placement of the two charts on the original supporting table of the scanner by an operation error of the user and to execute a process same as in the case where the charts are properly placed.

Consequently, the printer calibration apparatus of the second embodiment is same in the basic configuration as the first embodiment, but is different in detecting the inverse placement of the two charts on the original supporting table of the scanner and executing data processing in a same manner as in the case of proper placement, and also in the control method thereof.

In the following there will be explained portions different from the first embodiment.

The configuration of the printer calibration system of the second embodiment is similar to that of the foregoing first embodiment shown in Fig. 1.

In the following there will be explained, with reference to Figs. 2A and 2B, a case where the chart is placed in a vertically inverted position on the original supporting table of the scanner. In Fig. 2A, there are shown a scanner apparatus 20 corresponding to the scanner 3, an original supporting table 21, an original point 22 for aligning the original, usually provided in the ordinary scanner apparatus, and a chart 23 which can be a scanner chart A of the form shown in Fig. 15 or a printer chart B of the form shown in Fig. 6. In the present embodiment these two charts are processed in the same manner, so that the following description will be made, as an example, on the printer chart B shown in Fig. 6. There is also shown discrimination data 24 which corresponds to the arrow mark 63. In Fig. 6, there are also shown a lower left registration mark 64, an upper left registration mark 65 and an upper right registration mark 66 which are used for discrimination whether the sheet is placed in a vertically inverted position, as will be explained later.

Fig. 2A shows a state in which the chart is properly placed on the original supporting table, and the data processing is executed assuming that the chart is placed in such state in which the arrow-shaped mark 24 is positioned upward. However the user may place the chart in an inverted state as

shown in Fig. 2B. In such case, it is possible to draw the attention of the user for example by displaying a registration mark detection error as in the foregoing first embodiment, but, if the chart is in a completely inverted state, the process can be continued by internally rearranging the format and the present embodiment is to realize such configuration.

Now the process flow of the second embodiment will be explained with reference to Figs. 13 and 14.

As explained in the foregoing, the present embodiment relates to a process in scanning the chart with the scanner, and such process is executed in reading the printer chart in the step S44 in Fig. 4 and in reading the scanner chart in the step S120 in Fig. 12. Thus, as in the discrimination process in the first embodiment, this process is executed after the data of the chart of A4 size are once stored in the memory.

Referring to Fig. 13, a step S130 discriminates whether the chart is placed in the inverted position. The flow of the discrimination process will be explained with reference to Fig. 14, taking the printer chart B shown in Fig. 6 as an example. Referring to Fig. 14, a step S140 detects the lower left registration mark 65. Since the size of the chart is determined in advance, the number of pixels between the data constituting the chart can be

uniquely determined by fixing the scanning resolution of the scanner apparatus. The detection of the lower left registration mark 65 is executed by searching, in the memory storing the read chart data, a black (non-white) area of a pixel number corresponding to such registration mark, within an area predetermined from the lower left corner of the A4 sized-area. If there is identified a failure in detecting the lower left registration mark in the step S140, a step S145 returns an error signal. If a registration mark detection error signal is returned in this discrimination step, an error display is executed in an upper layer but such error display will not be shown. The content of the error message is the registration detection error 173 shown in Fig. 17.

If step S140 succeeds in detecting the registration mark, a step S141 checks the possibility of inverted placement. More specifically there is detected whether the registration mark detected in the step S140 is the upper left registration mark placed in an inverted position. This detection is achieved by the difference in the shapes of the upper left and lower left registration marks 64, 65 shown in Fig. 6.

If the step S141 judges that the detected registration mark is not the upper left registration mark, steps S142 and S143 execute detection of the upper left and upper right registration marks. In

case of proper detection, a step S144 returns a signal indicating the normal state. In case of an error in the step S142 or S143, the step S145 returns an error signal as explained in the foregoing.

If the registration mark detected in the step S141 is judged as the upper left registration mark, the chart is possibly placed in the inverted position. In such case a step S146 executes detection of the lower left registration mark, and, in case of detection, a step S147 executes detection of the upper right registration mark. If all these registration marks are detected, a step S148 returns a signal indicating that the chart is placed in the inverted position. In case of an error in the step S147 or S148, the step S145 returns an error signal as explained in the foregoing.

If the step S130 in Fig. 13 judges the inverted placement of the chart, a step S131 rearranges the data in the memory storing the read chart data. Such rearrangement is executed in such a manner that the data at the upper left corner (arrangement 1, 1) in Fig. 6 come to the lower right corner position (arrangement 32, 32). In such case, it is naturally possible also, instead of actually rearranging the data, to turn on a flat indicating the inverted placement for example in the step S131, and to refer to such flag in the memory access in a subsequent step

and to execute the memory access in consideration of such flag in case of the inverse placement.

As explained in the foregoing, the second embodiment provides a method of detecting the vertically inverted placement of the chart on the original supporting table of the scanner and allowing to continue the process as in the case of normal placement, whereby the inverted placement of the chart is not processed simply as an error but the process can be continued in the same manner as in the case of normal placement by interval data rearrangement thereby realizing calibration of improved convenience of use.

[Third Embodiment]

In the following there will be given a detailed explanation on a third embodiment of the present invention.

In contrast to the first embodiment designed to execute automatic discrimination and to provide error display in case the scanner chart and the printer chart to be used in the calibration are erroneously used by an operation error of the user, the third embodiment is so designed as to detect a skewed placement of the two charts on the original supporting table of the scanner by an operation error of the user and to execute an error display.

Consequently, the printer calibration apparatus

of the third embodiment is same in the basic configuration as the first embodiment, but is different in detecting the skewed placement of the two charts on the original supporting table of the scanner and executing an error display, and also in the control method therefor.

In the following there will be explained portions different from the first embodiment.

The configuration of the printer calibration system of the third embodiment is similar to that of the foregoing first embodiment shown in Fig. 1.

In the following there will be explained, with reference to Fig. 3, a case where the chart is placed in a skewed position on the original supporting table of the scanner. In Fig. 3 there is shown a chart 30 which is placed in a skewed position, different from the normal state shown in Fig. 2A, with respect to the original supporting table. Such skewed state cannot ensure the proper reading of the information of the chart. For example, if the reading of A4 size is instructed to the scanner, the chart in such skewed state may overflow from the frame of A4 size.

In such case it is necessary to indicate the operation error to the user and request that the user places the chart in the proper position.

In the present embodiment the scanner chart A and the printer chart B are processed in the same manner,

so that the following description will be made, as an example, on the printer chart B shown in Fig. 6. There is also shown discrimination data 24 which corresponds to the arrow mark 63. In Fig. 6 there are also shown a lower left registration mark 64, an upper left registration mark 65 and an upper right registration mark 66 which are used for discrimination whether the sheet is in a skewed position, as will be explained later.

Now the process flow of the third embodiment will be explained with reference to Fig. 19.

As explained in the foregoing, the present embodiment relates to a process in scanning the chart with the scanner, and such process is executed in reading the printer chart in the step S44 in Fig. 4 and in reading the scanner chart in the step S120 in Fig. 12. Thus, as in the discrimination process in the first embodiment, this process is executed after the data of the chart of A4 size are once stored in the memory.

Referring to Fig. 19, a step S191 discriminates whether the chart is placed in the normal position. The flow of the discrimination process will be explained with reference to Fig. 20, taking the printer chart B shown in Fig. 6 as an example. Referring to Fig. 20, a step S200 detects the lower left registration mark 65. Since the size of the

chart is determined in advance, the number of pixels between the data constituting the chart can be uniquely determined by fixing the scanning resolution of the scanner apparatus. The detection of the lower left registration mark 65 is executed by searching, in the memory storing the read chart data, a black (non-white) area of a pixel number corresponding to such registration mark, within an area predetermined from the lower left corner of the A4-sized area. If there is identified a failure in detecting the lower left registration mark in the step S200, a step S207 returns a registration mark detection error signal. If the step S200 succeeds in detecting the registration mark, a step S201 checks whether the position of the registration mark is within the range of allowance. In case of skewed placement, the position of the registration mark is displaced, and there is confirmed whether the amount of such displacement is accommodated within a range of allowance defining the skewed position.

Such range of allowance is not explained further but is determined empirically. If the step S201 identifies that the amount of displacement is outside the allowance range, a step S208 returns a skew error signal.

If the step S201 identifies that the amount of displacement is within the allowance range, a step

S202 detects the upper left registration mark, based on the positional relationship to the lower left registration mark.

If detection is made, a step S203 checks whether the position of such registration mark is within the range of allowance. This is to confirm whether the relative displacement of the upper left registration mark with respect to the lower left registration mark, namely the level of skew, is within the range of allowance. If outside the range of allowance, a step S208 returns a skew error signal. The detection of the upper right registration mark is executed in a similar manner. Referring to the flow in Fig. 20, in a normal state, a step S206 returns a signal indicating the normal state, and, in a skewed state, a step S208 returns a skew error signal, and, if the detection of the registration mark is not possible, a step S207 returns a registration mark detection error signal. Referring to Fig. 19, if a step S191 identifies an abnormal state, a step S192 executes an error display. In case of a registration mark detection error, there is provided a display 173 shown in Fig. 17, and, in case of a skew error, there is displayed an error window 160 shown in Fig. 16.

As explained in the foregoing, the third embodiment provides a method of detecting the skewed placement of the chart on the original supporting

table of the scanner and executing error display, thereby realizing calibration of higher precision.

[Fourth Embodiment]

The present embodiment provides a variation of the scanner chart to be employed in the foregoing embodiments.

In the following there will be explained, with reference to Figs. 21, 22A and 22B, a format of the scanner chart different from that explained in the foregoing embodiments.

Fig. 21 shows an example of the scanner chart of the present embodiment. In Fig. 21, an entire scanner chart is shown by a frame 210 of A4 size. A data portion 212 consists as in the example shown in Fig. 15, of 1024 blocks in total, composed of 32 divisions in the vertical and lateral directions in a page.

Discrimination information 213 is provided in an arrow shape for indicating the direction of the chart when it is placed on the original supporting table of the scanner apparatus, and, in case of the scanner chart, contains therein a letter "A" for causing the user to identify this chart as a scanner chart. Registration marks 214, 215, 216 are similar to those shown in Fig. 15.

A folding margin 217 is provided for folding the chart A in such a manner that the folding margin 217 is positioned inside the fold, and data portions 212

are positioned on both sides of the folding margin 217.

The above-described scanner chart A is a reference sheet, printed in advance for example by offset printing, and has to be stored by the user. The ordinary offset print may be discolored by ultraviolet light. Even in an ordinary office environment, if the user leaves the chart A with the printed side upward close to a window, the chart may be discolored within a relatively short period and may become unusable for the intended purpose.

The chart A in the present embodiment is so designed as to improve the light resistance of such chart in a relatively inexpensive manner.

Referring to Fig. 22A, there is shown a chart A 221 with a folding margin 222 corresponding to that 217 shown in Fig. 21. In case of storing the chart A, it is folded at the folding margin 222, with the printed surface inside, as shown in Fig. 22A. Fig. 22B shows a manual 224 to be packed with a calibration software, with a pocket 224 for storing the chart. A chart 225, corresponding to the aforementioned chart 221, is stored in the folded state in the pocket of the manual in order to avoid ultraviolet irradiation to the printed surface. Such configuration can improve the light resistance of the chart A relatively inexpensively, even including the

cost of the pocket 224 to be attached to the manual 223.

As explained in the foregoing, the present embodiment considers the storability of the chart thereby improving the precision and the convenience of use.

[Other Embodiments]

The present invention is applicable to a system consisting of plural equipment or an apparatus consisting of a single equipment. Also the present invention is naturally applicable to a case where the present invention is attained by supplying a system or an apparatus with a program. In such case, a memory medium storing the program of the present invention constitutes the present invention, and the system or the apparatus functions in a predetermined manner by reading such program from the memory medium into such system or apparatus.

The scope of the present invention is defined by the scope of the appended claims, and is not limited at all by the specific descriptions of this specification. Furthermore, all the modifications and changes belonging to equivalents of the claims are considered to fall within the scope of the present invention.

WHAT IS CLAIMED IS:

1. An image processing method comprising:

a step of generating a calibration condition for image forming means, by reading a first chart formed by said image forming means with reading means and generating a calibration condition for said image forming means, based on the data obtained by said reading;

a step of generating a calibration condition for said reading means, using a second chart printed in advance; and

a discrimination step of discriminating said first and second charts;

wherein said discrimination step discriminates whether a chart read in each of said step of generating calibration condition for image forming means and said step of generating calibration condition for image reading means is an appropriate chart.

2. An image processing method according to claim 1, wherein each of said first and second charts is provided with a mark formed by a color corresponding to a kind of the chart; and

said discrimination step discriminates the color of said mark.

3. An image processing method according to claim 1, further comprising a step of informing to a user when said chart is discriminated as inappropriate.

4. An image processing method for generating a calibration condition matching the characteristics of an apparatus based on data obtained by reading a chart, the method comprising steps of:

detecting, from said data, a mark attached to said chart; and

discriminating whether said data are appropriate according to a result of said detection.

5. An image processing method according to claim 1, further comprising:

informing a user of a fact that the reading position or the resolution in reading said chart is inappropriate, according to a result of said detection.

6. An image processing method according to claim 5, further comprising:

discriminating whether said chart is skewed according to the result of said detection; and

informing a user of skewed position when said chart is skewed.

7. An image processing method according to claim 4, further comprising:

informing a user of a fact that a kind of said chart is inappropriate, according to a result of said detection.

8. An image processing method according to claim 4, further comprising:

judging a direction of said chart according to a result of said detection; and

generating said calibration condition from said detected data according to said direction.

9. An image processing method for entering read data obtained by reading a chart printed in advance with reading means and generating calibration data for calibrating said reading means based on said read data;

wherein said chart is rendered foldable with the printed surface thereof inward and is not printed with a patch in the vicinity of the folding portion, and said chart is stored in an operation manual of said image processing method in a state folded in said folding portion with the printed surface thereof inward.

10. An image processing method according to

claim 9, wherein said chart is printed with plural same patches in different positions.

11. An image processing method according to claim 9, wherein the patches printed on said chart are larger in number in the highlight portion than in the shadow portion.

12. An image processing method according to claim 9, wherein said chart is printed with information indicating that said chart is for calibrating the reading means.

13. An image processing method according to claim 9, further comprising:

entering density data of each of the patches contained in said chart printed in advance; and

generating said calibration data based on said read data and said density data.

14. An image processing method according to claim 9, wherein said reading means reads an original image and to output RGB image data.

15. An image processing method according to claim 9, further comprising:

entering data obtained by reading, with said

reading means, a chart image formed by image forming means based on patch data;

correcting said data using said calibration data; and

generating calibration data for calibrating said image forming means based on said corrected data.

16. An image processing apparatus comprising:

means for generating a calibration condition for image forming means, by reading a first chart formed by said image forming means with reading means and generating a calibration condition for said image forming means, based on the data obtained by said reading;

means for generating a calibration condition for said reading means, using a second chart printed in advance; and

discrimination means for discriminating said first and second charts;

wherein said discrimination means discriminates whether a chart read in each of said means for generating calibration condition for image forming means and said means for generating calibration condition for image reading means is an appropriate chart.

17. A computer readable recording medium storing

a software of an image processing method, the method comprising:

a step of generating a calibration condition for image forming means, by reading a first chart formed by said image forming means with reading means and generating a calibration condition for said image forming means, based on the data obtained by said reading;

a step of generating a calibration condition for said reading means, utilizing a second chart printed in advance; and

a discrimination step of discriminating said first and second charts;

wherein said discrimination step discriminates whether a chart read in each of said step of generating calibration condition for image forming means and said step of generating calibration condition for image reading means is an appropriate chart.

18. A chart to be used in an image processing method for entering read data obtained by reading a chart printed in advance with reading means and generating calibration data for calibrating said reading means based on said read data;

wherein said chart is rendered foldable with the printed surface thereof inward and is not printed with

a patch in the vicinity of the folding portion, and said chart is stored in an operation manual for said image processing method in a state folded in said folding portion with the printed surface thereof inward.

ABSTRACT OF THE DISCLOSURE

The invention intends to calibrate a reading unit, thereby enabling highly precise calibration of an image forming unit in constant manner. It also intends to improve the convenience of use of the calibration process for the reading unit and of the calibration process for the image forming unit.

The invention provides an image processing method comprising a step of generating a calibration condition for image forming unit, by reading a first chart formed by the image forming unit with a reading unit and generating a calibration condition for the image forming unit, based on the data obtained by the reading; a step of generating a calibration condition for the reading unit, using a second chart printed in advance; and a discrimination step of discriminating the first and second charts; wherein the discrimination step discriminates whether a chart read in each of the step of generating calibration condition for image forming unit and the step of generating calibration condition for image reading unit is an appropriate chart.

FIG. 1

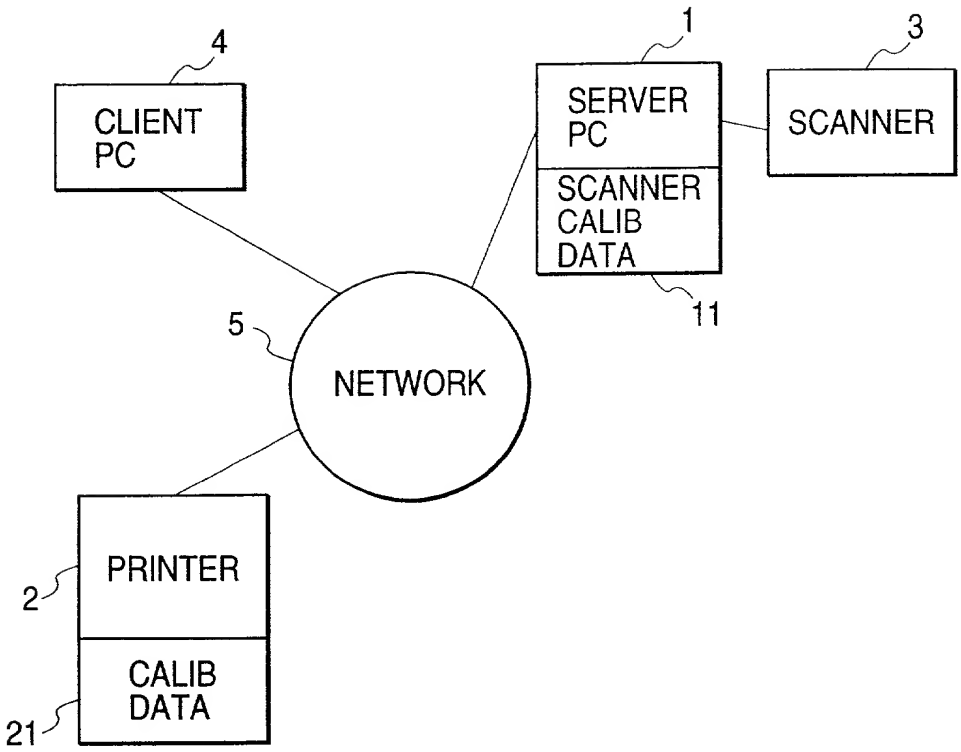
4
CLIENT PC
1
SERVER PC
SCANNER CALIB DATA
11
3
SCANNER
5
NETWORK
2
PRINTER
CALIB DATA
21

FIG. 2A

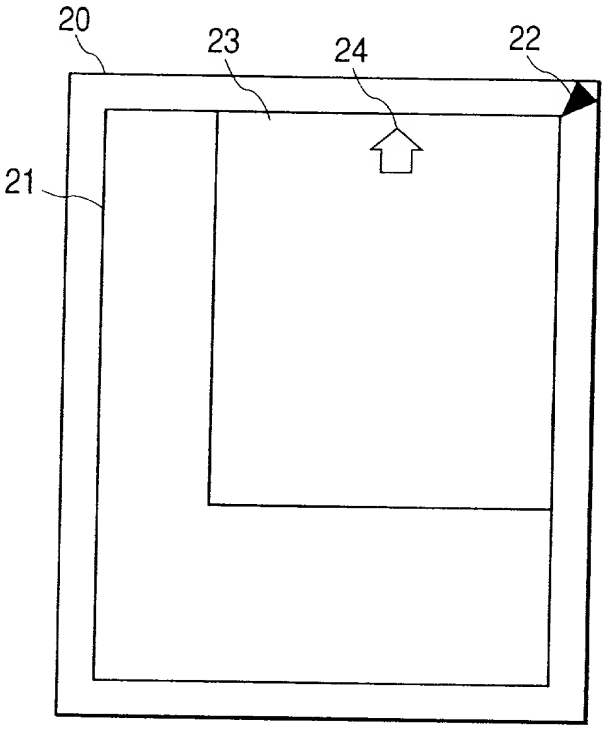

FIG. 2B

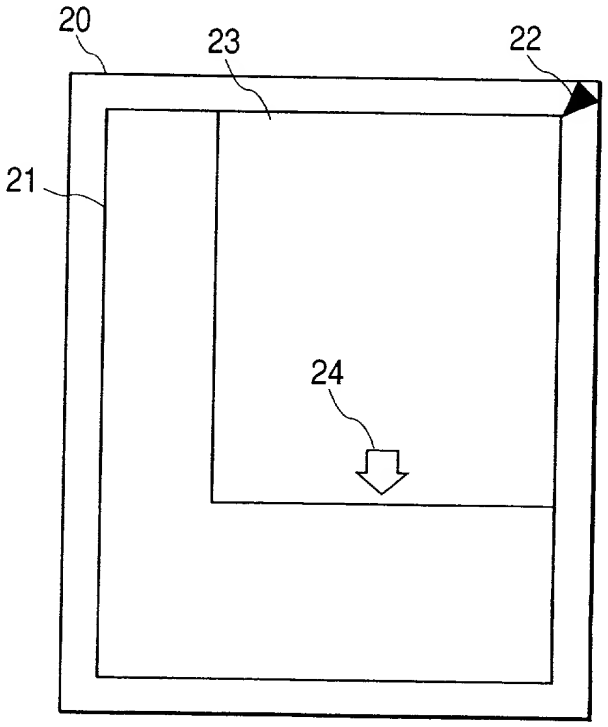

FIG. 3

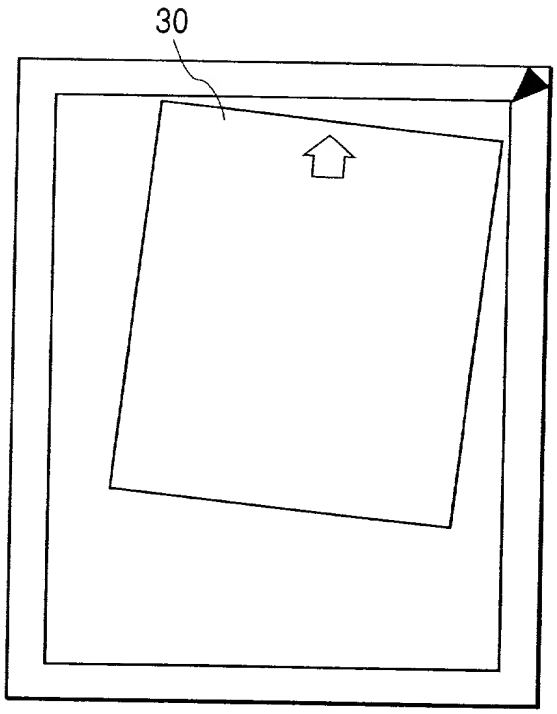

FIG. 4

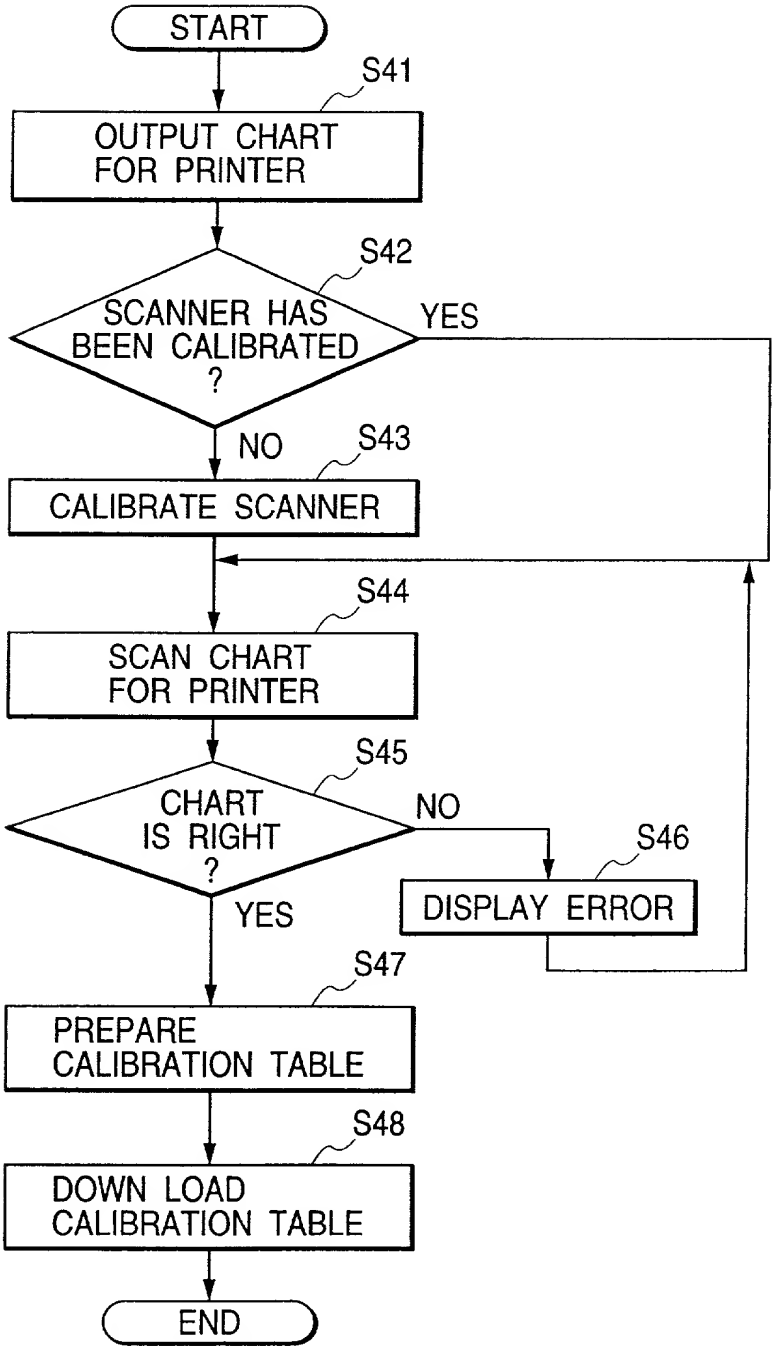
START
S41
OUTPUT CHART FOR PRINTER
S42
SCANNER HAS BEEN CALIBRATED ?
YES
NO
S43
CALIBRATE SCANNER
S44
SCAN CHART FOR PRINTER
S45
CHART IS RIGHT ?
NO
S46
DISPLAY ERROR
YES
S47
PREPARE CALIBRATION TABLE
S48
DOWN LOAD CALIBRATION TABLE
END

FIG. 5A

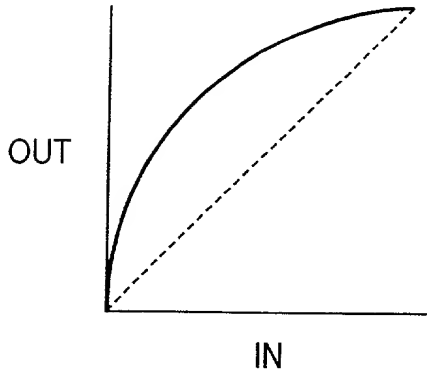

FIG. 5B

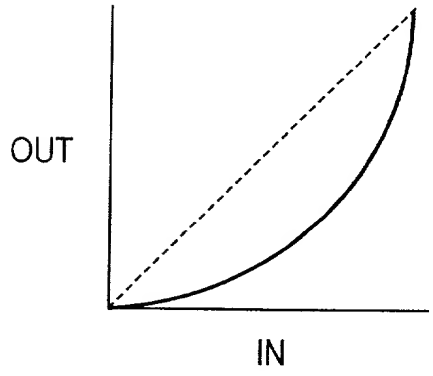

FIG. 5C

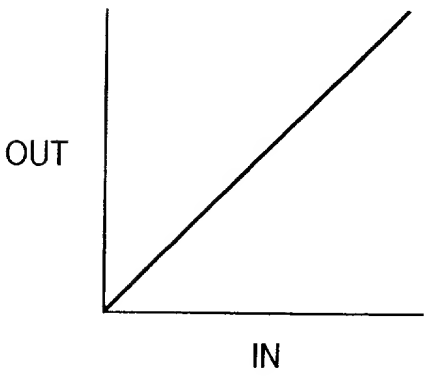

FIG. 6

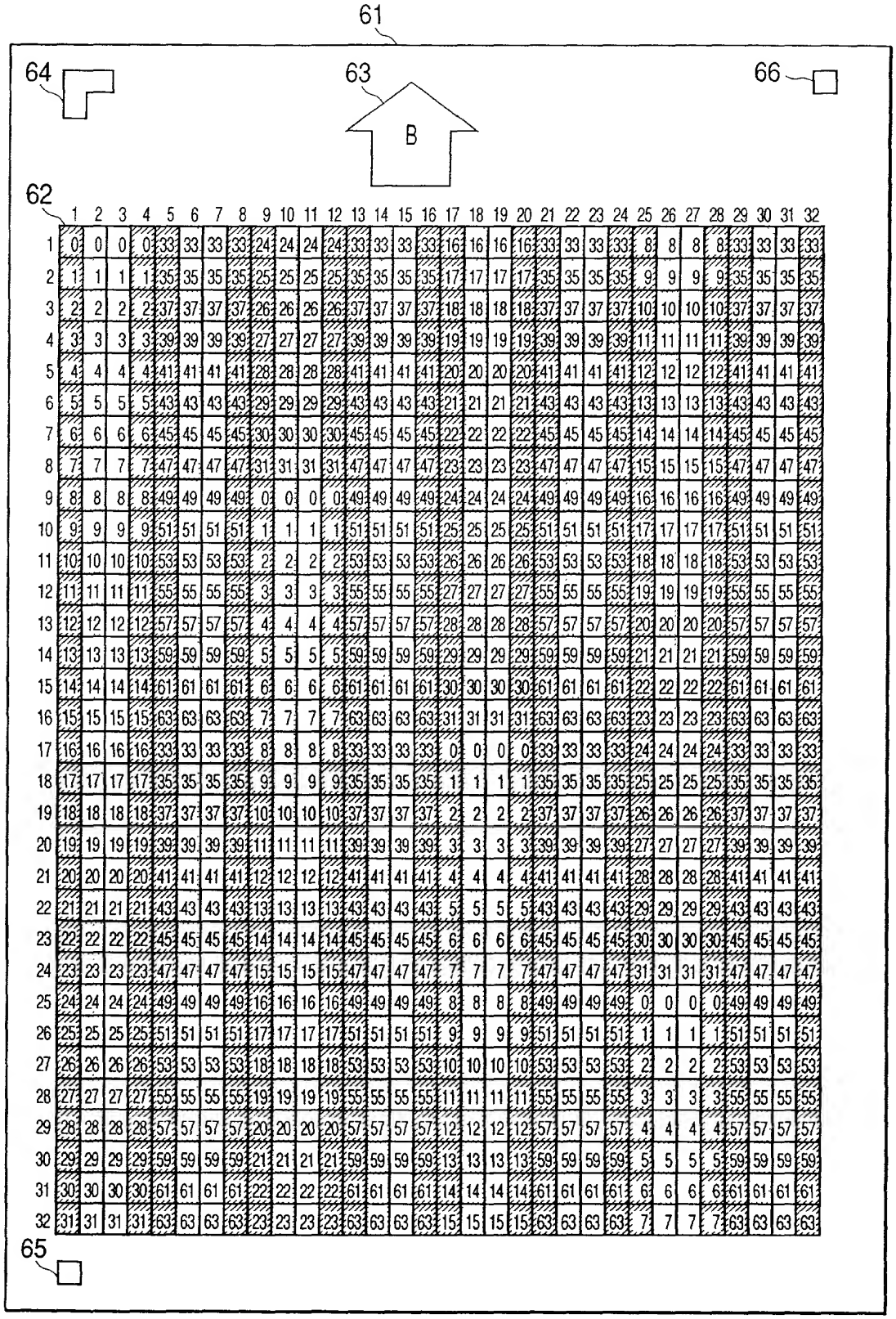

FIG. 7

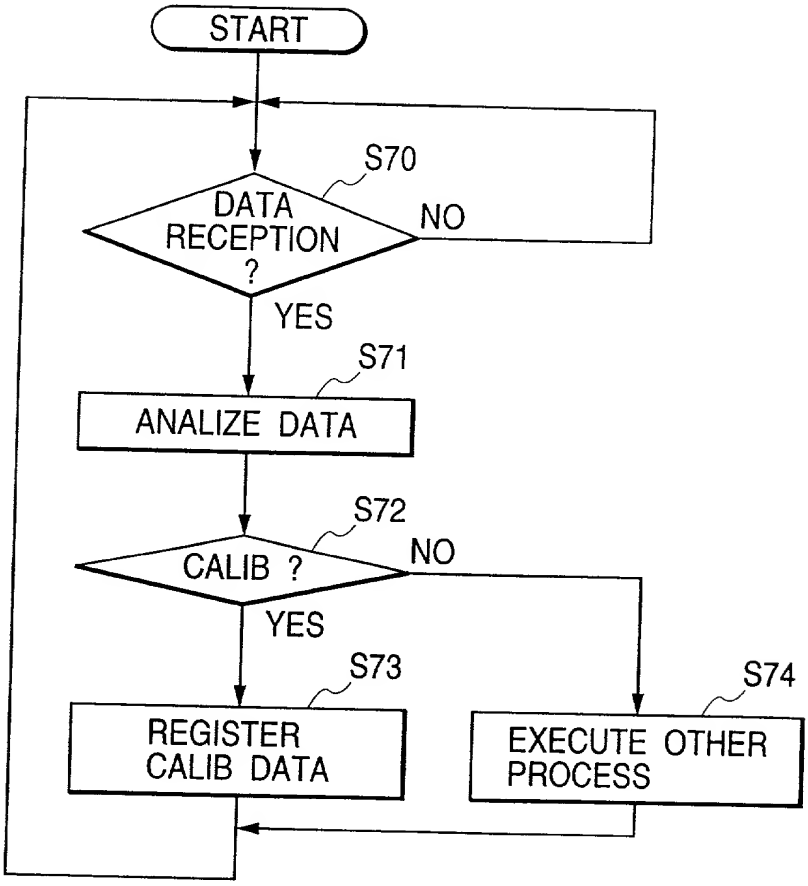
START
S70
DATA RECEPTION ?
NO
YES
S71
ANALIZE DATA
S72
CALIB ?
NO
YES
S73
REGISTER CALIB DATA
S74
EXECUTE OTHER PROCESS

FIG. 8

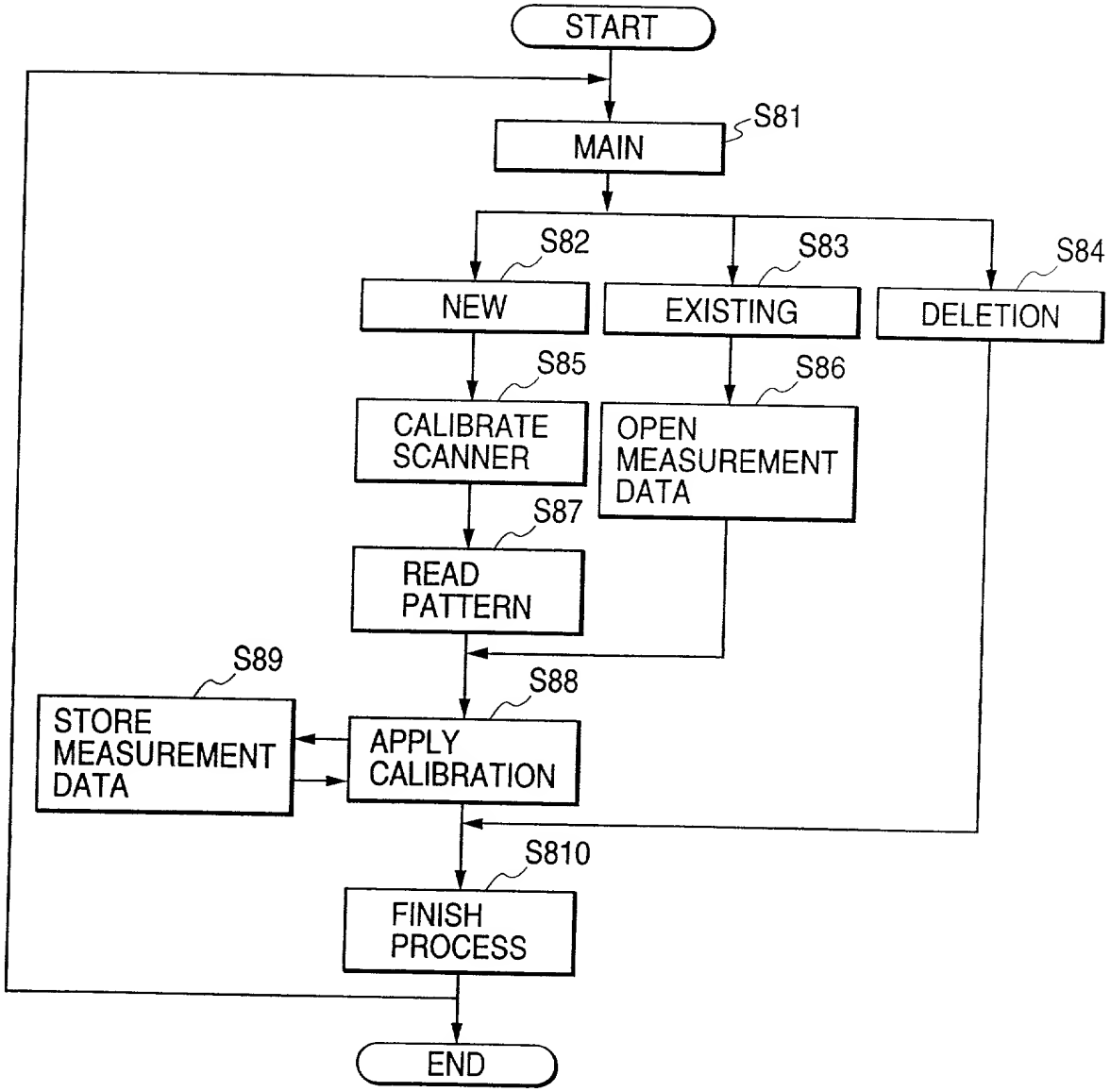
START
MAIN
S81
S82
S83
S84
NEW
EXISTING
DELETION
S85
S86
CALIBRATE SCANNER
OPEN MEASUREMENT DATA
S87
READ PATTERN
S89
S88
STORE MEASUREMENT DATA
APPLY CALIBRATION
S810
FINISH PROCESS
END

FIG. 9

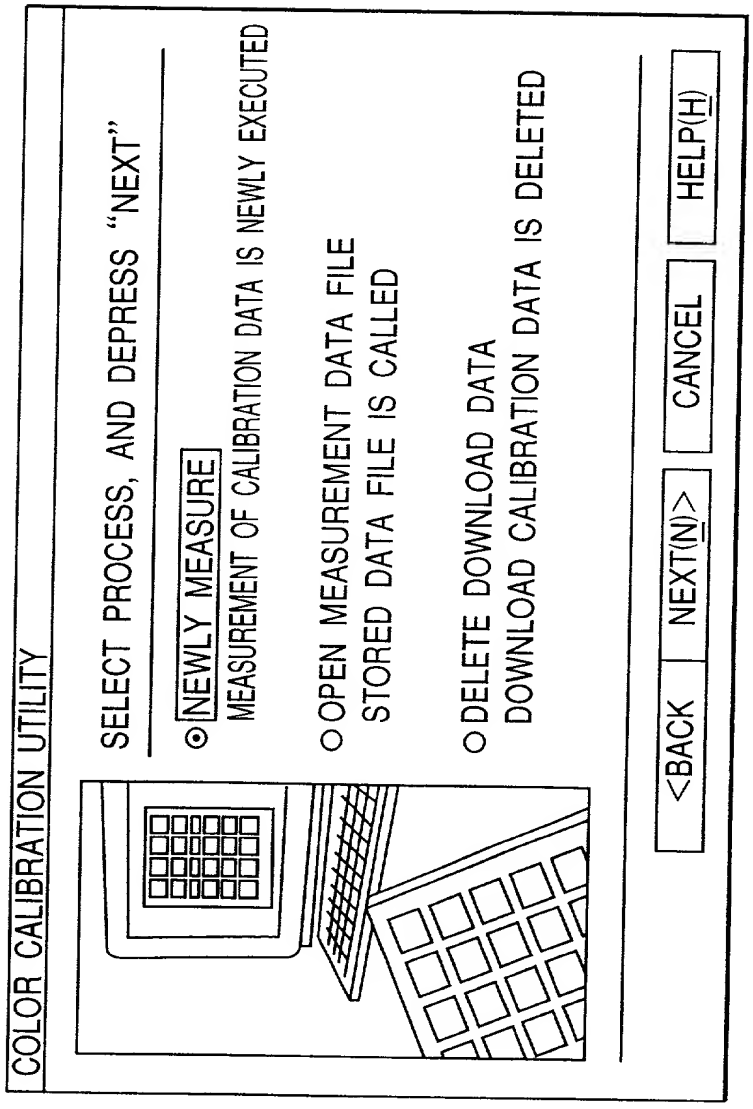
COLOR CALIBRATION UTILITY
SELECT PROCESS, AND DEPRESS "NEXT"
NEWLY MEASURE
MEASUREMENT OF CALIBRATION DATA IS NEWLY EXECUTED
OPEN MEASUREMENT DATA FILE
STORED DATA FILE IS CALLED
DELETE DOWNLOAD DATA
DOWNLOAD CALIBRATION DATA IS DELETED
<BACK
NEXT(N)>
CANCEL
HELP(H)

FIG. 10

APRAY	REAL OUTPUT DATA
0	0
1	4
2	8
3	12
4	16
5	20
6	24
7	28
8	32
9	36
10	40
11	44
12	48
13	52
14	56
15	60
16	64
17	68
18	72
19	76
20	80
21	84
22	88
23	92
24	96
25	100
26	104
27	108
28	112
29	116
30	120
31	124
32	128
33	132
34	136
35	140
36	144
37	148
38	152
39	156
40	160
41	164
42	168
43	172
44	176
45	180
46	184
47	188
48	192
49	196
50	200
51	204
52	208
53	212
54	216
55	220
56	224
57	228
58	232
59	236
60	240
61	244
62	248
63	255

FIG. 11

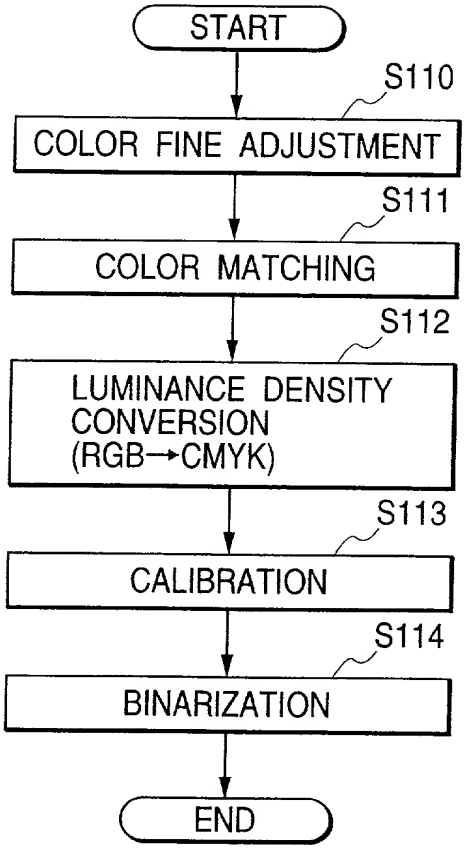
START
S110
COLOR FINE ADJUSTMENT
S111
COLOR MATCHING
S112
LUMINANCE DENSITY CONVERSION (RGB→CMYK)
S113
CALIBRATION
S114
BINARIZATION
END

FIG. 12

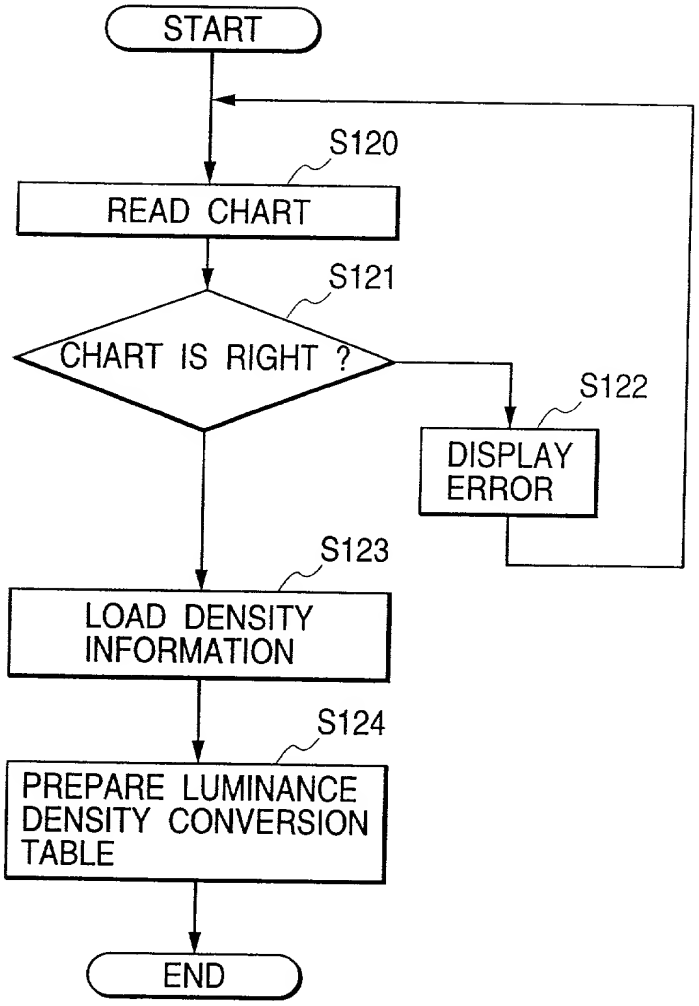
START
S120
READ CHART
S121
CHART IS RIGHT ?
S122
DISPLAY ERROR
S123
LOAD DENSITY INFORMATION
S124
PREPARE LUMINANCE DENSITY CONVERSION TABLE
END

FIG. 13

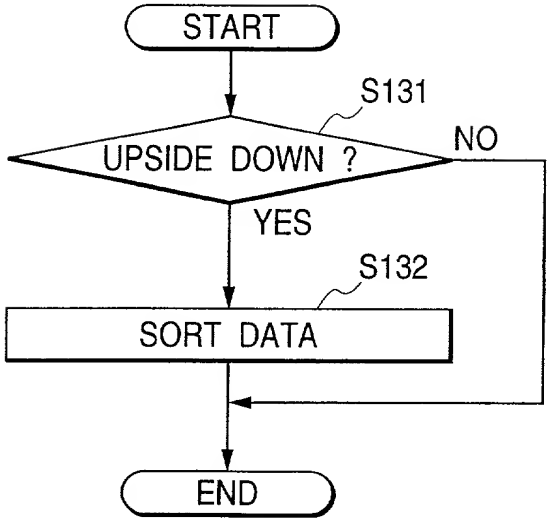

FIG. 14

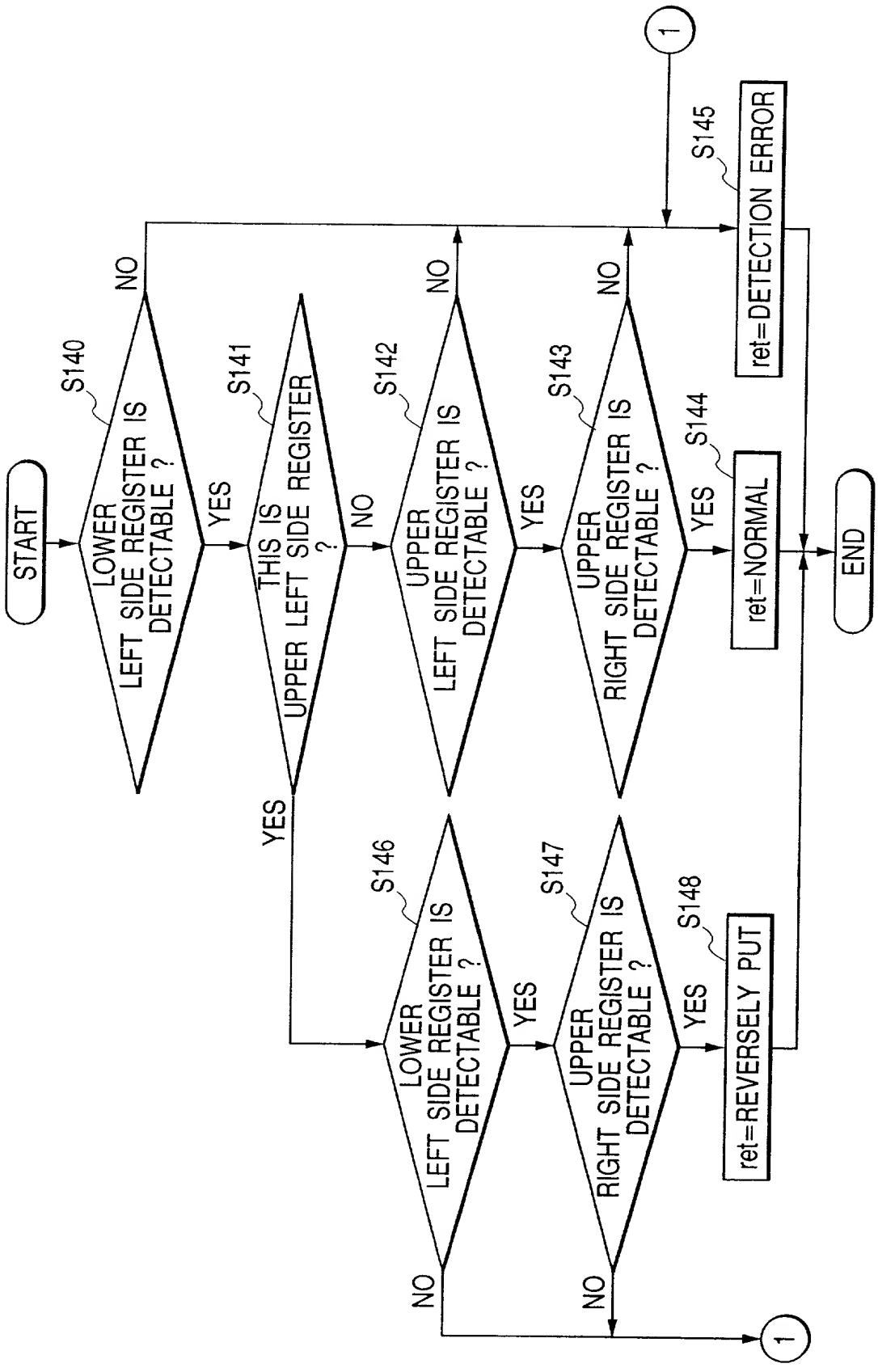
START
S140
LOWER LEFT SIDE REGISTER IS DETECTABLE ?
NO
YES
S141
THIS IS UPPER LEFT SIDE REGISTER ?
NO
YES
S142
UPPER LEFT SIDE REGISTER IS DETECTABLE ?
NO
YES
S143
UPPER RIGHT SIDE REGISTER IS DETECTABLE ?
NO
YES
S144
ret=NORMAL
S145
ret=DETECTION ERROR
END
S146
LOWER LEFT SIDE REGISTER IS DETECTABLE ?
NO
YES
S147
UPPER RIGHT SIDE REGISTER IS DETECTABLE ?
NO
YES
S148
ret=REVERSELY PUT
1
1

FIG. 15

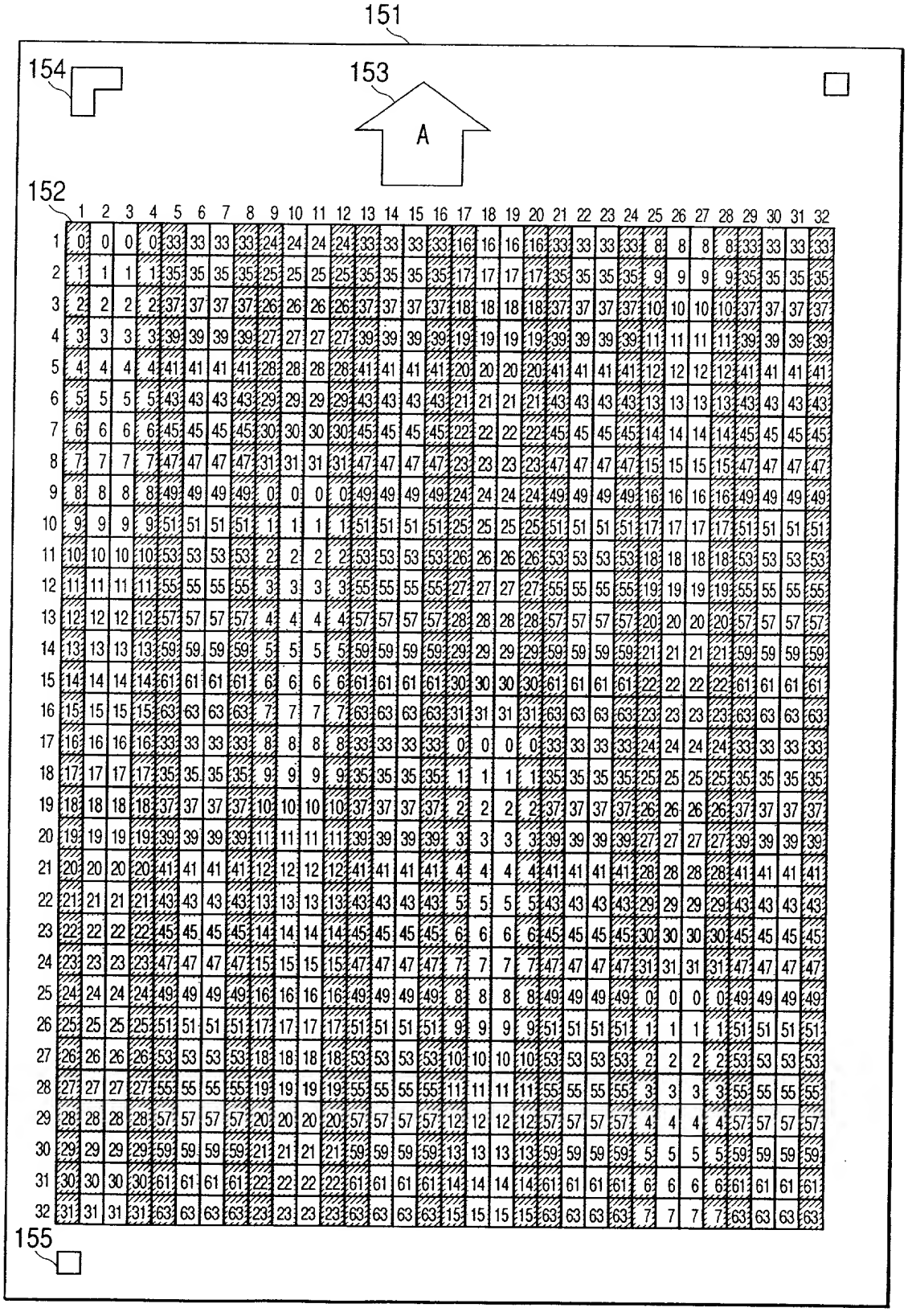

FIG. 16

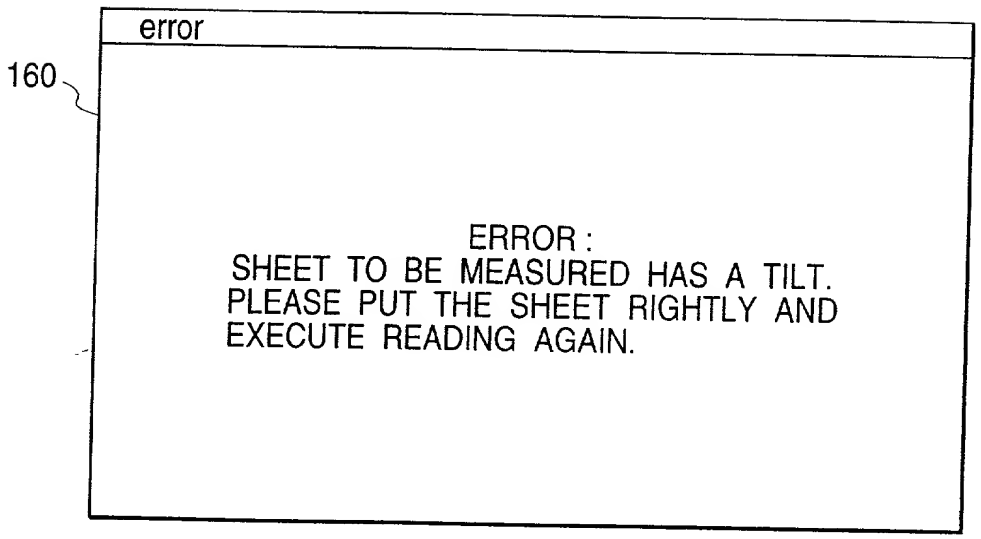
error
160
ERROR :
SHEET TO BE MEASURED HAS A TILT.
PLEASE PUT THE SHEET RIGHTLY AND
EXECUTE READING AGAIN.

FIG. 17

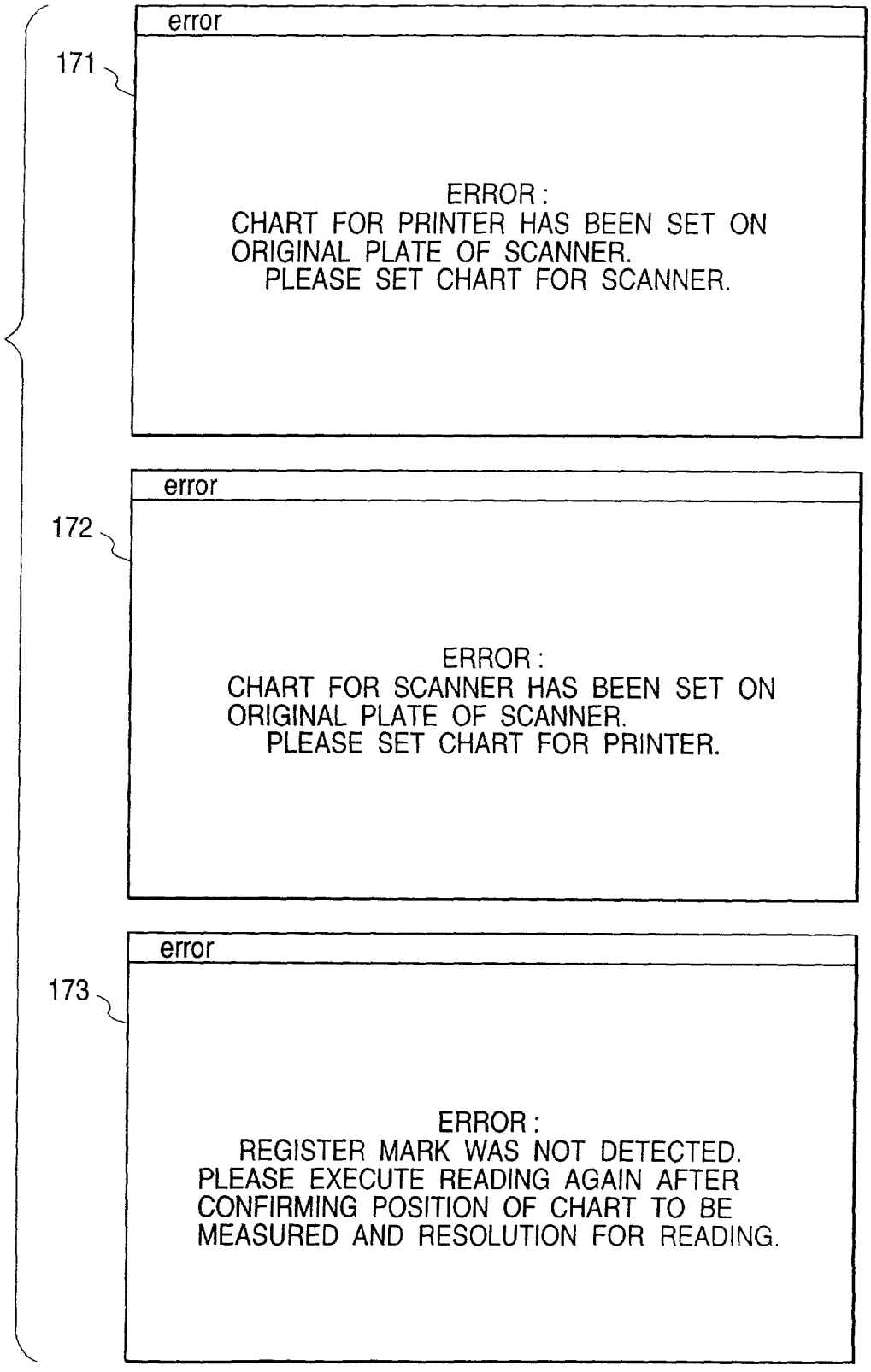

FIG. 18

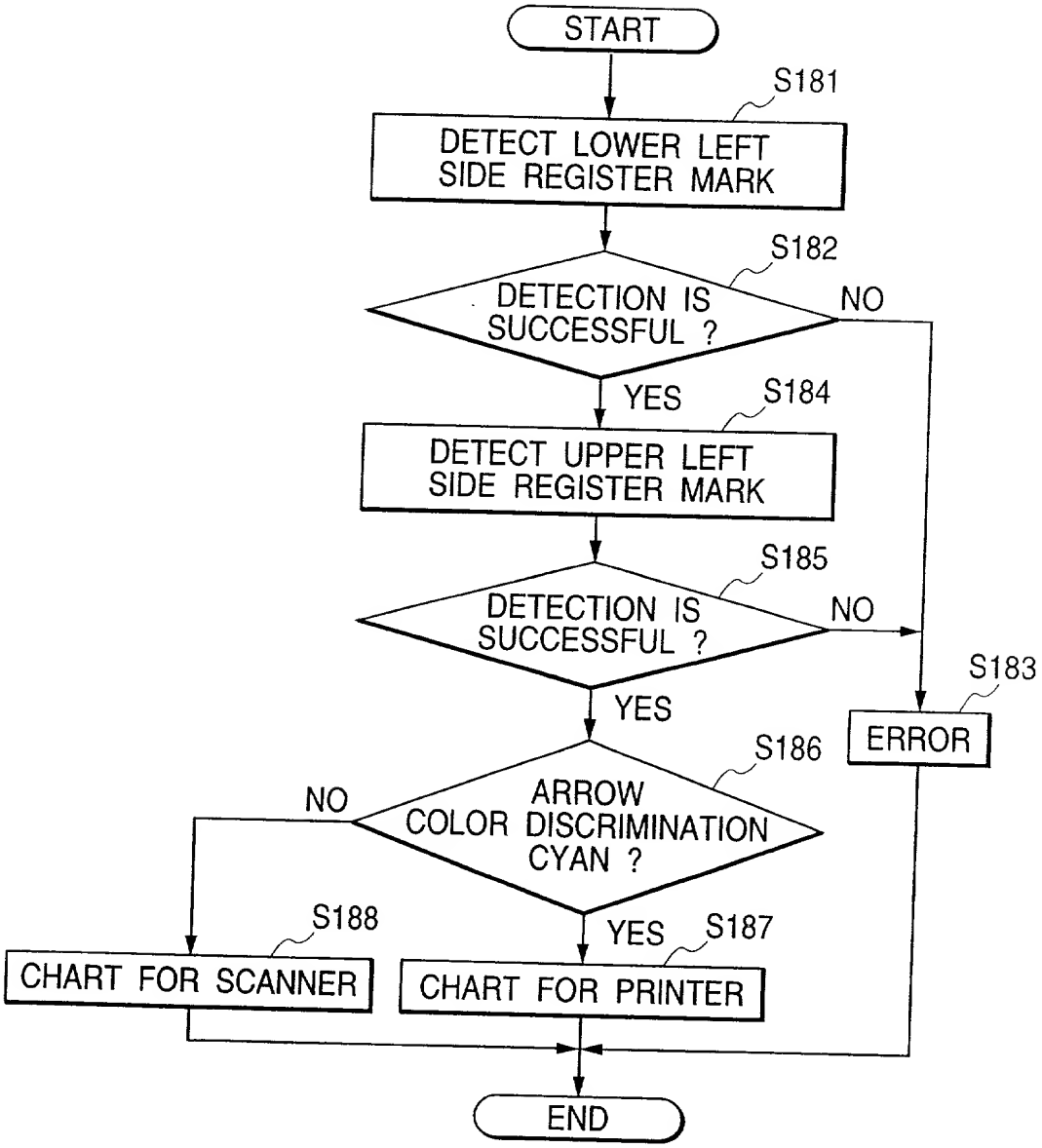
START
S181
DETECT LOWER LEFT SIDE REGISTER MARK
S182
DETECTION IS SUCCESSFUL ?
NO
YES
S184
DETECT UPPER LEFT SIDE REGISTER MARK
S185
DETECTION IS SUCCESSFUL ?
NO
YES
S183
ERROR
S186
ARROW COLOR DISCRIMINATION CYAN ?
NO
YES
S188
CHART FOR SCANNER
S187
CHART FOR PRINTER
END

FIG. 19

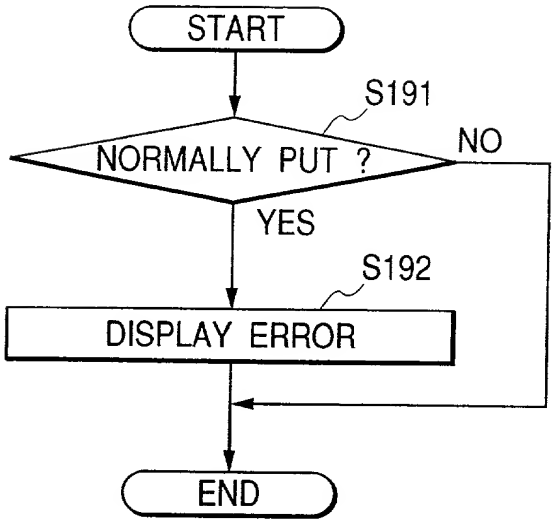

FIG. 20

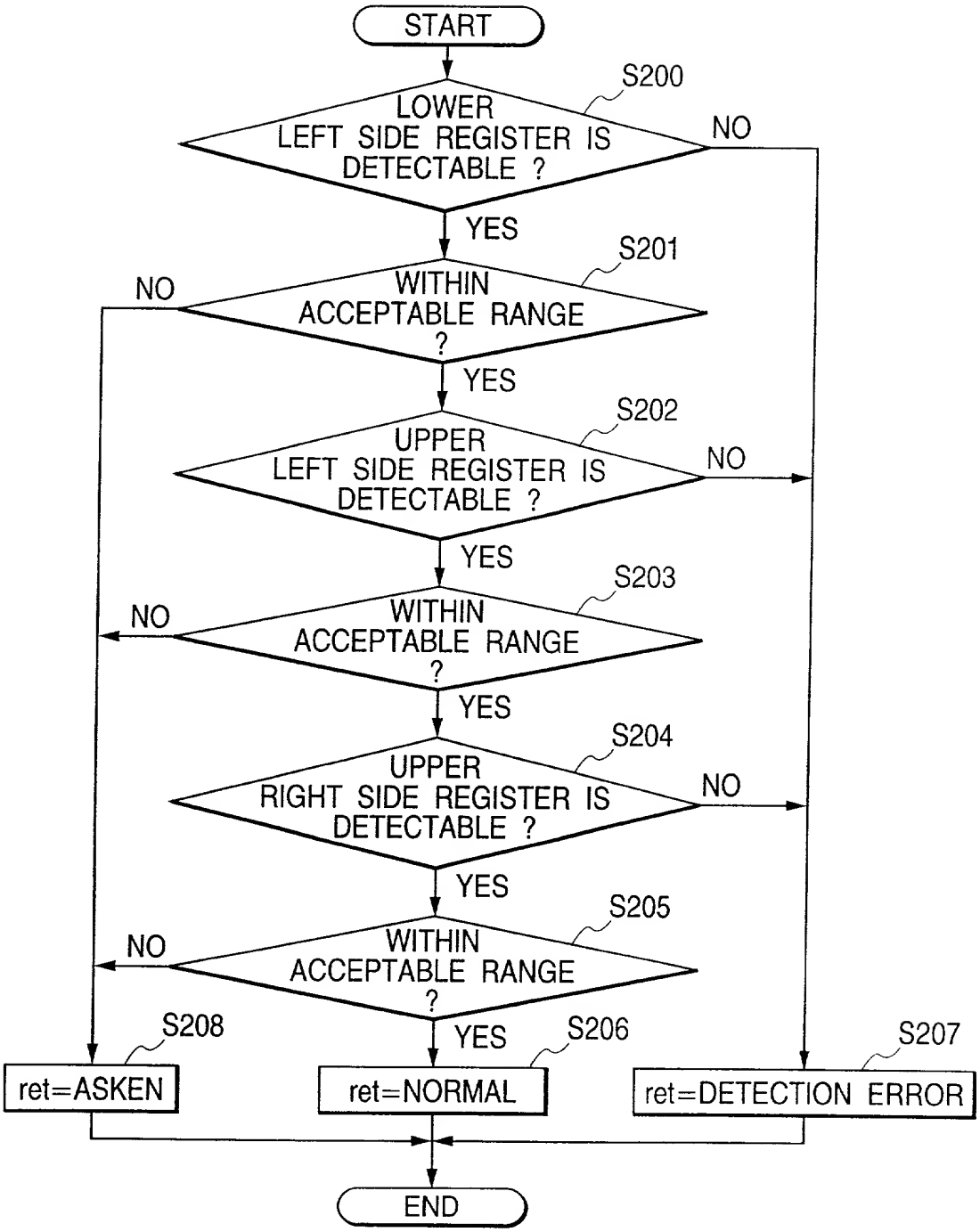
START
S200
LOWER LEFT SIDE REGISTER IS DETECTABLE ?
NO
YES
S201
WITHIN ACCEPTABLE RANGE ?
NO
YES
S202
UPPER LEFT SIDE REGISTER IS DETECTABLE ?
NO
YES
S203
WITHIN ACCEPTABLE RANGE ?
NO
YES
S204
UPPER RIGHT SIDE REGISTER IS DETECTABLE ?
NO
YES
S205
WITHIN ACCEPTABLE RANGE ?
NO
YES
S208
S206
S207
ret=ASKEN
ret=NORMAL
ret=DETECTION ERROR
END

FIG. 21

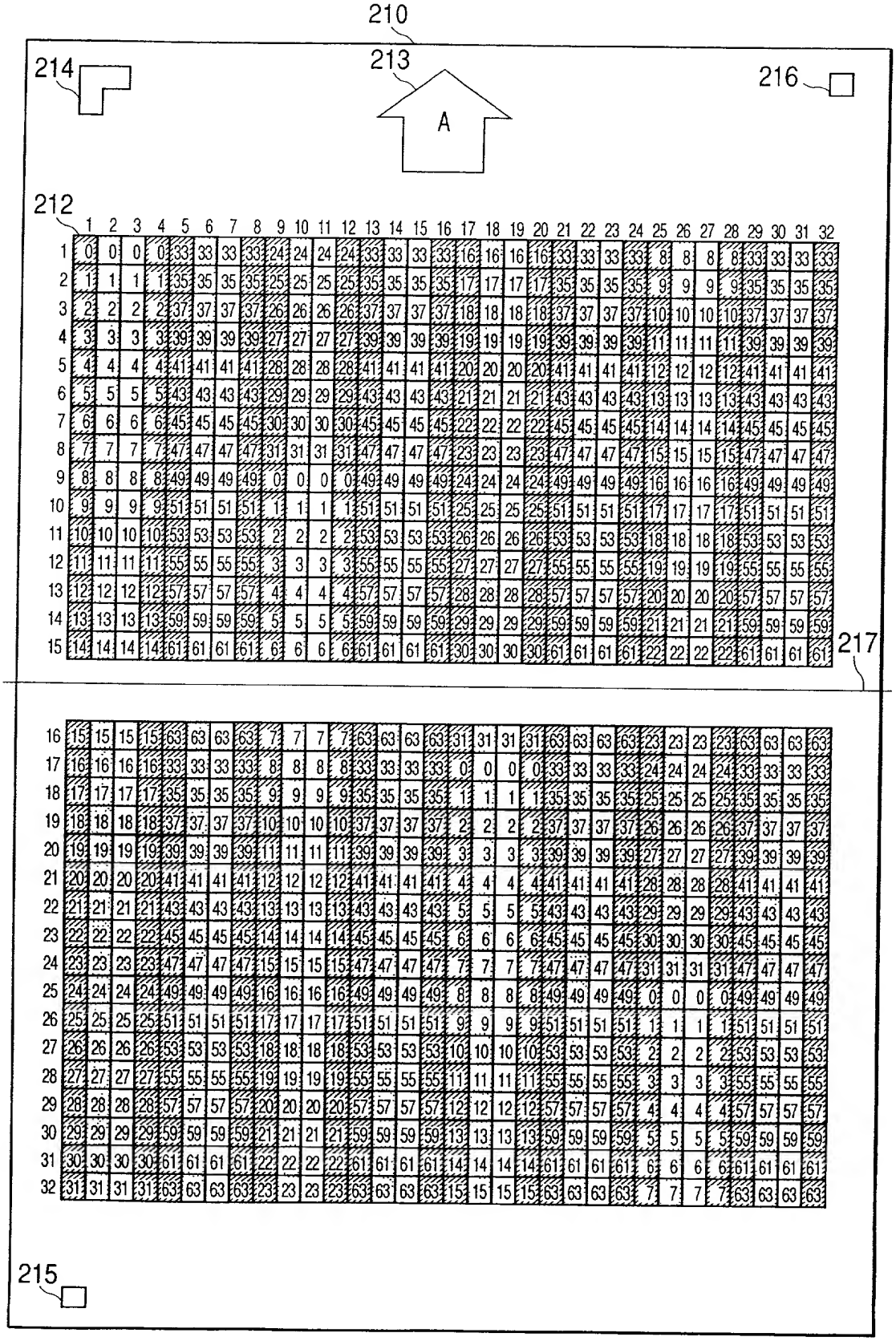

FIG. 22A

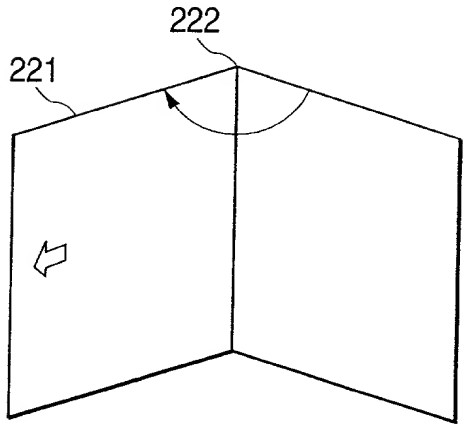

FIG. 22B